THE KEEPER: JOURNAL OF THE AMERICAN ASSOCIATION OF ZOO KEEPERS

edited by Ron Kaufman and Chris LaRue

THE KEEPER: JOURNAL OF THE AMERICAN ASSOCIATION OF ZOO KEEPERS

VOLUME I 1975

edited by Ron Kaufman and Chris LaRue

THE KEEPER

Journal of the American Association of Zoo Keepers

Volume I 1975

AAZK Board of Directors:
Ed Roberts, Boston, Ma., President
Rick Steenberg, Topeka, Ks., Exec. Secretary
Mike Dee, Los Angeles, Ca.
Terry Mc Donald, Calgary, Alberta, Canada
Pat Sass, Chicago, Ill.
Curtis Williams, Boise, Id.

Published by ANIMAL KEEPERS' FORUM
Ron Kaufman
Chris LaRue
Vicky LaRue
Judie Steenberg

Publication of this journal was made possible through the generous contribution of ZuPreem, Hill's Division of Riviana Foods, Inc. and through the kind support of Dr. Richard Carte and Jerry K. Houghlan.

Articles in this journal may be reprinted with the permission of the authors, credit to this journal is requested.

Copies of THE KEEPER may be obtained by writing to: ANIMAL KEEPERS' FORUM, 635 Gage Blvd., Topeka, Ks. 66606. Cost is $5.00, make checks payable to Animal Keepers' Forum.

Cover photo: Cotton-Headed Tamarin (Saguinus oedipus)
by Ron Kaufman, Topeka Zoo

CARING IS THE FIRST STEP

by Barry N. Wakeman, Cincinnati Zoo, Cincinnati, Ohio

Emphasis on ecology, conservation and animal welfare has aroused more interest in zoo related careers than ever before.

There are opportunities in this expanding field, but only for the capable, responsible and properly trained. Some light should be shed on exactly what zoo work is, what job opportunities are available in the zoo field, and what preparation is needed for a zoo career.

There are 353 zoological parks, game farms, and aquariums belonging to the American Association of Zoological Parks and Aquariums. The 1972 AAZPA directory lists 272 zoos in the United States, 81 zoos in Canada, Mexico, and South America, and more than 12 zoo-associated government agencies, zoological organizations and conservation groups. The 50 largest U.S. zoos average 62 full-time employees: keepers, zoologists and curators, gardeners, maintenance crews and park managers, zoo educators and administration staff.

The majority of positions are held by animal keepers. In the past such positions were held by men, required no special education and involved little originality, imagination or initiative. Today, some zoos require that starting keepers have a college degree and all zoos give preference to those applicants with education and experience dealing with animals. Most zoos now accept female keepers in areas not requiring excessive physical labor and in such positions as the animal nurseries, female keepers are preferred.

Reliability, patience and hard work have always been part of a good keeper's job, but today's keepers must do more. Keepers must be able to observe and record medical problems, administer some medication, adjust the vitamin-mineral and dietary intake to the needs of each individual animal in his care, give public tours and lectures and know how to meet the behavioral, psychological and reproductive requirements of his charges. Animal management is demanding and exciting, but the keepers must also spend tedious hours in cleaning cages, preparing food plates and picking up after thoughtless zoo visitors. Many college-educated people unfortunately feel the janitorial aspects of the keeprs position are beneath them.

At the Cincinnati Zoo, keepers in the Aquarium must have a knowledge of chemistry as they make 2000 gallons of artificial salt water per week and run regular tests on the water the pH factors, salinity and ammonia content. Keepers in the Ape House and Nursery co-operate with the University of Cincinnati's Anthropology Department in conducting primate studies. Keepers from several departments participate in zoo lecture programs and evening talks to school, church, scout and other civic organizations.

Cincinnati Zoo keepers are also involved in manufacturing cage decor by making realistic fiberglass models from rocks, trees, and other natural objects, and then using the sturdy, non-toxic models in creating natural appearing cage decoration. Keepers often make appearances on television shows, talking about their animals. The photographs taken by one keeper are used in zoo lectures. Several keepers help write educational signs. Others help make scientific study specimens from animals that have died. The Cincinnati Zoo, like all progressive zoos, uses and encourages the diverse talents of its keepers. The zoologists and curators supervise the animal collection and the keepers who care for it. They must know the dietary, medical, caging and handling needs of every animal to insure proper up-to-date animal management. It is helpful to have had experience working as a keeper to promote the understanding and teamwork needed between keepers and staff.

Giving lectures, writing articles, designing graphic displays and setting up cage decor, teaching docents and keepers, administering minor veterinary care and working closely with all aspects of zoo management give zoologists and curators a demanding, challengingand rewarding job. As their titles infer, zoologists and curators have a strong background in biology, zoology, botany, taxonomy, genetics, ecology, parasitology, physiology, and related studies. Today, a college degree and often a Master's or Ph.D. in biological science is necessary.

Modern zoos realize and are meeting their responsibility, not only as entertainment centers, but by promoting education, conservation and research. Consequently good zoos offer the public varied educational programs, and may have complete departments dealing with public education in nature, animal welfare and conservation. Certified teachers with a background of wildlife education often find rewarding zoo careers.

The Cincinnati Zoo hires high school and college students to work in the Children's Zoo each summer. There are only a dozen positions available for which more than 500 applications are received annually. The work involves cleaning out animal pens, picking up after the public and watching over the contact between animals and children. Some students, in their impatience to pursue careers in veterinary medicine or wildlife managemnt, consider this work boring. Others learn about the responsible care and diet for animals and discover that the first contact between animal and child is an important educational experience and that they can enhance and develop the patience needed in working with animals.

If one's basic motivation to a career is material riches, it is good advice to look elsewhere than the zoo field. The attitude of many zoo people is well expressed by Robert Perrill, a keeper at the Arizona Sonora Desert Museum who writes, "Money, although necessary, is one of the least of my concerns. Primarily, I want a place where I can be happy, learn and grow while working with, studying and photographing animals." People in zoo work seldom expect to become wealthy, but those who make up the rank and file of workers within the field have a high sense of service to the animal world and to mankind.

The important key to working, whether in the Children's Zoo, as part-time summer help or as a keeper, zoologist, curator, educator, or zoo director is not only based on one's natural gifts or lucky opportunities, but on acquired traits such as posture, dress, speech and thinking habits. Among the special skills, writing and speaking abilities are tremendous assets and they can be acquired. Participation in professional societies; working summers (either voluntarily or paid) in park system zoos, veterinary clinics, or in animal-related work helps one prepare for a zoo career. In the Cincinnati area, one should look into the educational classes given by the zoo, Museum of Natural History, the Nature Center, the City and County Park Systems and the Aullwood Audubon Center, as well as the activities sponsored by groups like the Sierra Club, Wildflower Preservation Society, the Drydredgers (fossils) and others too numerous to mention. Education should be pursued as far as one can, on the broadest scale possible. Do not specialize until graduate school.

One Cincinnati Zoo keeper recently said, "There is more, much more to work than earning a living." His work has brought him the deep satisfaction of doing a job he loves and the knowledge that he has served the animal world and mankind through bringing them a little closer together.

This is the reward of a good zoo man.

Reprint from "Your Cincinnati Zoo News", Spring 1973.

A SUCCESSFUL REINTRODUCTION OF A HAND-REARED COTTON-TOP MARMOSET *SAGUINUS OEDIPUS* TO ITS FAMILY

by Kathryn Le Clere, Chicago Zoological Park, Brookfield, Illinois

Twins were born to the pair of cotton-top marmosets *Saguinus oedipus* in the Small Mammal House at Brookfield Zoo on September 5, 1973. The parents reared one infant while the other, rejected at birth, was hand-reared.

Although physically sound, the hand-reared infant grew ever more emotionally dependent upon humans. By one month of age, Zelda, as we called her, persistantly screamed when not permitted human contact and habitually sucked her genitalia during periods of stress.

It was decided to provide her with contact from other marmosets. At the age of one month (34 days), by which time she had begun consuming solid food, she was placed in a wire cage within the exhibit and reintroduced to her parents and the male sibling. This brief encounter indicated the adults would willingly accept her, so the use of the wire cage was discontinued. The adults attempted to protect her during some of the early encounters, threatening the keeper and positioning themselves between the keeper and Zelda. Zelda, however, was extremely frightened of her family. Several encounters followed (Table 1). They were run on an almost daily basis and were each from three to nine hours in duration. When about three months (95 days) of age, Zelda remained in the exhibit permanently.

Several problems arose during the course of the project. One of the earliest dealt with providing warmth and security for Zelda during the encounters. A towel, to which she could cling, fastened to a branch in the exhibit provided security, but insufficient warmth. The solution involved placing a small glass aquarium tank (in which she had been reared) on a heating pad on the floor of the exhibit. Soft, clean rags in the tank provided her with something on which to cling and hide, and the warmth of the heating pad discouraged her previous inactivity. A branch protruding from the tank promoted interactions between Zelda and her family. A lid placed on the tank allowed her to remain in the exhibit at night, beginning when she reached one and a half months (44 days).

Zelda had a minor setback when she was almost two months (51 days) old. She appeared to be getting somewhat thin and more upset than before, and was removed from the exhibit for ten days while encouraged to gain weight. Afterward, she was returned to the exhibit for periods of three to eight hours a day and removed at night. Use of the tank was no longer necessary.

Zelda was less fearful of her sibling than of the adults. After a good deal of persistant effort, the sibling was allowed to approach and eventually touch her. Though Zelda occasionally approached the adults, she screamed and sometimes swung to the underside of a branch when either adult approached her. This behavior occurred with less frequency until Zelda reached three and one half months (108 days), by which time it had ceased.

Play between the youngsters consisted primarily of chasing, hair-pulling, and screaming, and evolved to include wrestling, mounting, and pushing against each other. The sibling initiated play at the start, but within several days both youngsters were soliciting play equally. If the play became very intense, the female often approached and sniffed or nipped at Zelda.

Grooming between the youngsters was first observed shortly after play behavior began. Zelda often sat quietly, eyes closed, while her sibling groomed her. If she screamed, as she often did, the sibling licked her mouth and cheeks. As time passed, Zelda began grooming her brother in return.

Zelda was observed approaching the

adult male with more frequency than the female. She began spending increasingly longer periods with him. Unfortunately, he died shortly thereafter when the twins were almost four months (114 days) old.

Zelda's relationship with her mother involved a minimum of interaction until Zelda was nearly four and one half months (149 days) old. At this point she was finally allowed to approach and groom the female. Later, she was permitted to take food from the female, although her sibling had been observed engaging in the same behavior more than three months (45 days of age) earlier. Her sibling was carried by his parents until almost five months (141 days) of age. Zelda never rode her parents.

By the time Zelda was approximately four and one half months (149 days) old, she was no longer observed assuming the genital-sucking posture. This behavior was discouraged, in part, by the fact it was a near physical impossibility for her to perform without falling from a branch.

At five and one half months (160 days) of age, Zelda interacts quite amicably with the others and prefers their company to that of her keeper. Her reintroduction has proven far more successful than we had once believed possible.

Zelda, her mother, and sibling are still living together quite peacefully as of August, 1975. As she nears her second birthday Zelda still approaches and makes physical contact with her keepers, although she very often refuses to have anything whatever to do with them. To the casual observer her behavior is virtually indistinguishable from that of her cagemates. Earlier this month we observed Zelda and her sibling engaged in copulatory behavior. Although it could not be determined whether intromission was achieved, we are watching for more of such behavior and will most certainly be interested in observing Zelda's behavior should a birth result.

TABLE I

Reintroduction Schedule of a Juvenile Cotton-top Marmoset

Age (Days)	Cumulative Introduction Time (Hours)	Youngster's Behavior	Family's Behavior
38	20 min.	Screaming; genital-sucking	Protective; vain attempts to solicit mounting
44	32	Exploring begins (climbs out of tank and on branches): waits for keeper	Protective; approach less frequently
62	86	Defensive to other three	Sibling approaches her for first time, but retreats when threatened
70	114	Eats with others, but still screams when approached	Sibling persistently approaches
82	174	Plays with sibling	
95	253	Mutual grooming with sibling	Adults indifferent toward her

108	589	Sleeps in nest box with for first time; screams only when hungry	
149	1573	Grooms female; genital-sucking no longer observed	Mother finally allows youngster to groom her
152	1645	Takes food from female; almost indifferent to keeper	Mother readily relinquishes food
160	1837	Grooms and interacts amicably with others	

ORANGUTAN TOOL USE AT OKLAHOMA CITY ZOO

by Jim Ellis, Jr., Assistant Manager, Glen Oak Zoo, Peoria, Illinois

The orangutan *Pongo pygmaeus* group at the Oklahoma City Zoo has been observed on numerous occasions performing certain behavioral activities which can be classified as tool use. These activities fit the most basic definition of a tool, which is the use of an object for some purpose or function (Goodall, 1971; Babcock, 1963). All three of our orangutans have been observed manipulating or using various objects as tools. One type of tool modification has been observed, on several occasions, being performed by our female orangutan, Lotus, and will be discussed below. The objects used as tools are sticks, food items, and tires. These are either present in the cage or provided for consumption and or play daily. The three orangutans to be discussed are a 17 year old female, Lotus; a 12 year old male, LesTunku; and a 2 year old male, Foots. At present we have no statistical data available on these behavior patterns but all have been observed repeatedly and all occur spontaneously-with the exception of one which can be elicited from our female, Lotus.

LesTunku has three types of objects which he uses as tools; a tire, prying objects, and anything to absorb fluids. His use of the tire involves eating and drinking. Les will place the tire so that the constant flow spigot in the cage fills the tire with water. He may then carry the tire a few feet away and drink. After filling his mouth with his daily ration of milk, he may place it in the tire and may at times put pieces of monkey chow in it, eating or drinking at his leisure. He also uses the tires as a receptacle for dry monkey chow which he then eats in combination with his fruits and other foods. In conjunction with fluids, Les has been observed to repeatedly use a piece of rubber from a tire, lettuce leaves, or kale leaves as a sponge to soak up the liquids. He has on numerous occasions held out or dipped a large piece of orange peel in the stream of water from a hose after which he sucks on it. This may be repeated several times during each occurrence. He has also been seen on numerous occasions soaking or attempting to soak up soapy water or other interesting liquids just barely out of his reach at the front of the cage. He usually uses lettuce leaves, kale leaves, or mats of his own hair and will repeat the procedure several times. The remaining category entails using sticks or stiff objects for prying. In most cases the objects are not stiff enough to effect damage which in all likelihood would be extreme due to his perseverance and strength. Les has been observed working on a crack in the door or wall, placing the stick, carrot, or other tool in the crack, first with one end then the other. He may continue to do so for several minutes or up to an hour, frequently succeeding in apparent efforts to enlarge the crack by removing small chips of concrete.

Tool use in our female orangutan, Lotus, can be characterized by her use of objects to secure other objects beyond her reach. This activity is most often seen around feeding times when a food item may be out of her reach, but is also elicited when she becomes interested in objects such as signs and hoses. She will continue to choose different items or tools (e.g. lettuce or kale leaves, sticks, etc.) until she finds one which allows her to reach and successfully retrieve the object. This behaviour form can be elicited by baiting with a preferred food item or an object of interest. It is during these instances of tool use that Lotus has been observed modifying a kale leaf by stripping the stem and then using the stem to rake in another object (Dittmar, 1974). Lotus has another behavior form which could possibly be classified as tool use. She habitually stacks tires on the rear cage drain which effectively blocks the drain. She occasionally plays in the resulting pool but there does not seem to be a definite purpose to the act. If placed in another cage she will immediately stack all the tires on the drain in that cage. There does not seem to be any correlation of this activity with any of our daily husbandry and management activities except that it sometimes prevents us from properly cleaning the cage.

The two year old male, Foots, has recently been observed using tools. He has shown only two forms. The first was the use of a stick or branch in a threatening behavior. He has done this both towards a keeper and towards a 2' to 3' boa constrictor which was carried past him. He used these items to strike very vigorously towards the offending object. The other form of tool use was recently observed when, after poking his finger into a deep narrow hole, he picked up a stick and pushed it down the hole. He then withdrew it and placed it under his nose or tested it with his mouth. This was repeated several times during each occurrence until his interest in the area subsided.

All of the above behavior forms have been classified as tool use in comparison with similar occurring activities in the chimpanzee. We are extremely interested in finding out if these behavioral activities occur in general in captive orangutans or if they only occur in certain individuals or groups as has been reported to occur in chimpanzees (Bourne, 1974; De Vore, 1965).

References:

Babcock, P. ed., 1963. *Websters Third New International Dictionary.* Mass., G.C. Merriam Co.

Bourne, G.H., 1974. *Primate Odyssey.* New York, G.P. Putnam's Sons.

De Vore, I., 1965. *Primate Behavior*, New York, Holt, Rinehart, and Winston.

Dittmar, Fred, 1974. Personal communication.

Goodall, J., 1971. *In the Shadow of Man.* Boston, Houghton Mifflin Co.

Reynolds, V., 1967. *The Apes.* New York, E.P. Dutton and Co.

KEEPER INVOLVEMENT IN ZOO RECORDS

by Robert R. Peel, Calgary Zoo, Alberta, Canada

Because of public interest and concern about zoos, a new philosophy is evolving. Trends can be noted in several areas. Designs for new displays favor a naturalized although captive environment. Unrestricted species exhibit is rejected in favor of proper, restricted species exhibit. The creation of studbooks and species data banks are the initiation of a move towards planned breeding programs. Graphics and instructional aids receive further analysis. Zoos recognize their obligation to design, conservation and education.

Likewise, in the area of zoo records, a trend can be identified. Modern records have a more useful and trustworthy content. Both the number of contributors and the audience have enlarged. Data can be retrieved and produced at a faster pace.

As keepers, we are direct contributors to zoo records. It is worthwhile to define and highlight some major aspects of this field.

Internal uses of Zoo Records

1. *Management of Animals in Captivity*

Traditionally, keepers have recorded information on breeding dates, laying dates, and birth/hatching dates. These records allow the keeper to plan and implement precautions, for example, to remove the male, isolate the specimen from the public, make dietary changes, etc...

Breeding is the subject of concentrated recording. Documentation on successful/unsuccessful reproduction contributes to future success.

Techniques in husbandry vary in institutions and are also a subject of zoo records. The captive environment is unique to a particular locality and a particular display. Husbandry in an area that experiences an extreme climate is not equal to husbandry in an area that experiences a moderate climate. Nor is husbandry in one enclosure equal to husbandry in another enclosure. Differences in climate, size of display, quality of display, social interactions between the residents of the display, etc., all contribute to a type of management specialized to both the institution and display. Proper recording of this information is important for two reasons; to document these specialized techniques and routines for the benefit of all employees, and for analysis.

2. *Medical Records*

Records of diseases, disorders, treatments, sedations, vaccines, post mortems, etc., are required for obvious reasons.

A policy of maintaining related records on size and weight is advantageous in deciding questionable pregnancies, in determining dosage for sedation, in estimating the effects of a particular diet, etc.

3. *Inventory*

Knowledge of current inventory is essential to directors and curators. Frequently, replacements can only be ordered or sold at a certain time. In large collections an updated inventory requires the cooperation of all keeper staff. Each acquisition and removal requires daily recording.

External Uses of Zoo Records

1. *Management of Animals in Captivity*

References such as Crandall (1964) and the International Zoo Yearbooks (1960-1974) describe basic techniques that have been employed successfully at other institutions. Individual zoo records document confirmation of some basic techniques, and refute others.

2. Medical Records

Medical records gathered on a national or international basis are an asset to the veterinarian in caring for a particular collection.

3. Inventory

International inventory systems are of value to both external agencies and individual institutions. For example, the statistics may be used by the federal government to establish guidelines on the importing of wild animals. To the individual institution, the data may be used in deciding which specialization to pursue.

4. Dealing Between Institutions

The exchange of medical records and keeper information between transacting institutions leads to further honesty in animal dealing. Prices become more realistic with exposure to records on the specimen in question. Keeper information assists the receiving institution in calculating the dietary requirements and behavior characteristics of the new specimen.

5. Species Research

Mallinson (1974) describes the value of determining captive gestation periods to the study of the species biology. Likewise, there is an enormous interest in other areas such as longevity, breeding habits, anatomical comparisons, weights, sizes, number of progeny, etc. The zoo has the unique opportunity of generating a wealth of information on the species.

Duality in Zoo Recording

Due to the nature of zoo data there is a problem of objectivity and validity in collecting information. Ideally, two keepers would maintain records on the same specimens. Failing this, the best alternative is for the single individual to maintain two sets of records. As in other types of recording systems, duality in zoo records is favorable.

Keeper Training

There is the occasional keeper who does not cooperate in record keeping, or who requires constant supervision to ensure that he/she does maintain records. This disinterest can be traced to several causes (a) an ignorance of the uses of records (b) trusting information to memory rather than documentation (c) indolence. Keeper training in recording can remedy at least on of these causes.

In reviewing zoo recordng systems, it is apparent that there are two broad divisions of duty; input and compilation/analysis. Traditionally, the keepers provide the input, a single person or administrative department performs the compilation and analysis. It is unfortunate that some institutions do not recognize the merit of allowing keepers to participate in both programs. A training course which does not expose the employee to all aspects is incomplete.

Kleiman (1974) lists some disadvantages of conventional recording. Problem areas include a lack of analysis, a lack of routine, generalized formats which are not specialized for the species, etc. An active training course in zoo recording has the additional advantage of encouraging the institution to survery, define and correct these weak areas.

Summary and Conclusion

1. Zoo records have internal and external uses.

2. Dual recording increases the objectivity and validity of information input.

3. Training in zoo recording assists both the keeper staff and the institution. As part of the new zoo philosophy it is a responsibility of the keeper to participate in zoo recording. Zoo records upgrade the profession and add social and scientific value to the zoological institution.

Literature Cited

Crandall, Lee S., 1964. *The Management of Wild Mammals in Captivity.* The University of Chicago Press.

Kleiman, Devra G., 1974. Activity rhythms in the Giant Panda: an example of the use of checksheets for recording behavior data in Zoos. *Int. Zoo Yb.* 14: 165-169.

Mallinson, Jeremy J.C., 1974. Establishing mammal gestation periods at the Jersey Zoological Park. *Int. Zoo Yb.* 14: 184-187.

DIETARY SUPPLEMENTS FOR PENGUINS AT THE BALTIMORE ZOO

by Janet J. Gailey, Baltimore Zoo, Baltimore, Maryland

The colony of African Penguins *Spheniscus demersus* at the Baltimore Zoo has been in residence since May, 1967. The birds are kept in what was originally a large moated monkey island. Successful rearing of young first occurred in 1969 and has continued yearly. Although young have been reared every year, overall survival of chicks is low. For the most part this chick mortality has been attirbuted to "failure to thrive" as no pathological problem is evident. Death usually occurs during the first 10 days of life. This mortality problem is common among zoos that have had success in penguins nesting. To date no zoo seems to have found a solution to this perplexing problem.

Since animal reproduction is closely related to diet, this chick survival problem could be diet related. For the penguins in the wild, the diet is an assortment of marine invertebrates with some fish. For some species of penguins, such as the Adelie Penguin *Pygoscelis adelie,* fish comprise less than half of their total diet. In captivity, due to availability and cost, penguins are fed totally on fish. Logically, this could not be a balanced diet. To this conclusion we tentatively attribute this high chick mortality.

Methods

The penguins at the Baltimore Zoo always have been fed Atlantic Smelt which was supplemented with vitamins and salt. In 1972, thiamine (50 mg.) and cod liver oil (200 mg.) were added to the diet. The additional thiamine was to insure against a possible deficiency due to thiaminase in the smelt. In January, 1975, all viatmin supplements were replaced by a multi-vitamin plus minerals formulated especially for sea animals. Since the cod liver oil gave no indication of a positive effect it was discontinued.

From an article on Adelie Penguins it was learned of the positive effect on breeding by the addition of corn oil to the diet. Since reproduction taxes an animal's health more, it seems logical that at this time the diet should be enriched. For many mammals it is beneficial to enrich the diet by the addition of corn oil, especially during lactation. As an experiment, corn oil was instituted September, 1974. Each penguin received 2 to 3 cc's corn oil daily, injected into a fish.

Results

The nesting season for our colony begins in August, and birds can still be feeding young into May. Since the corn oil was instituted in September, it can be considered to start with the beginning of the 1974-1975 nexting season, and the resultant change in reproduction is apparently due to the corn oil. There was no other variable in the diet and maintenance of the colony. For the last two nesting seasons, the five pairs of nesters were the same birds. Three of the five pairs laid more clutches of eggs, with one pair laying five clutches during the 1974-1975 season. Changes from the 1973-1974 season to the 1974-1975 season include a total of 23 eggs to 33 eggs laid, and known fertile eggs jumped from 7 to 21. The number of chicks reared from the number hatched increased from 2 of 7 (29%) to 10 of 18 (56%). ("Reared" are chicks that are fully feathered, independent, and are eating readily on their own.)

While this positive effect has been observed on the productivity, the birds also have been observed very closely for possible negative effects from the oil. In May, three penguins (two juveniles and one adult) were lost. The adult and one juvenile were lost from avian malaria and the other juvenile from aspergillosis. The pathological report on the aspergillosis juvenile also showed many problems--among which was a marked vitamin E deficiency evidenced by muscle degeneration. This was not evident in the other autopsies. As vitamin E deficiency previously has not shown up in this colony, and vitamin E is utilized in greater quantities in the metabolism of polyunsaturated oils, it was believed that the corn oil was the cause. However, there is some doubt, since the other two showed no problems, and the juvenile in question was never a healthy individual. It is very likely that it had it's own metabolic imbalance.

Thus, since vitamin E deficiency is a slow process, and there always will remain a possibility of its occurrence with the use of the corn oil, it was recommended to supplement corn oil with additional vitamin E or change to wheat germ oil. Here at the Baltimore Zoo it has been decided to continue oil as a dietary supplement because of the reproductive successes, but because there is the possible correlation between the corn oil and the vitamin E deficiency, wheat germ oil will be replacing the corn oil.

Penguin Reproduction

Nesting Seasons

	1967-1968	1968-1969	1969-1970	1970-1971	1971-1972	1972-1973	1973-1974	1974-1975
Captive Age of penguins (yrs.)	1	2	3	4	5	6	7	8
Number producing pairs	2	5	3	4	5	5	5	5
Eggs laid total	4	11	14	15	21	22	23	33
Eggs laid (adjusted)*	3	8	8	6	18	11	17	28
Eggs fertile	0	6	7	4	14	9	7	21
Eggs hatched	0	4	7	4	13	7	7	18
Chicks reared	0	1	5	2	2	3	2	10

*This total does not include eggs that were smashed early, placed in incubators, or no record is given of final disposition.

A KEEPER BASED PROGRAM FOR MONITORING ENDOPARASITES

by Jeffrey A. Roberts, Brookfield Zoo, Brookfield, Illinois

One of the major problems in any animal collection is the prevention and control of parasitism. Too often parasites either contribute to or directly cause the death of an animal. In most zoos it appears that the rule of thumb pertaining to parasitism is that when an animal's stool is loose or when its behavior is abnormal, then and only then are stool or blood samples taken for analysis. Once the causative organism or organisms are identified, therapy is undertaken. Unfortunately, this can often be too late, particularly in very young or delicate individuals. Therapy is often so traumatic, such as forcing medicine down a stomach tube, or using a squeeze cage, dart gun, etc., that it may actually contribute to the animal's debilitated state. The basic point is that after a parasitic condition has shown itself symptomatically it is sometimes too late to reverse the effects. It is the familiar saying, "Preventive medicine is the best medicine".

Animals may harbor intestinal or blood parasites for a long period of time in a "carrier" state without showing any symptoms (Ruch, 1959, Snyder, 1975). The animals are basically healthy but if they are subjected to any stress, whether it be social, environmental, or dietary they may quickly succumb to a hyperinfection of their normally "silent" infection. It is possible for hormonal reactions to stress to facilitate the entry of a parasite into the body tissues, (Snyder, 1975). The ideal solution of course is to frequently examine the animal for blood or gastrointestinal parasites. Once "silent" infections are found they can be treated or closely monitored for any change. Unfortunately, few zoos have the services of a full-time parasitologist or microbiologist. Those that do often have such large collections that to frequently monitor every animal's stool would involve the technician working twelve hours a day, seven days a week.

A partial answer to the problem is for keepers to learn more about the parasitism of animals and, if motivated enough, to do some analysis on their own. Regularly drawing blood from your animals is admittedly inpractical, but frequent examinations of stools is easy and often productive, considering the number of parasitic helminths and protozoans. Most keepers are familiar with each animal's behavior and appearance, but how may are aware of the different possible parasites, their life cycles, and methods of control?

If your zoo is fortunate enough to have a full-time parasitologist, a visit to the hospital in your spare time is an excellent way to become familiar with what is affecting your animals. Local colleges often have night school courses in microbiology or parasitology. It is possible with a good scondhand microscope and a manual (e.g. Jeffrey, 1972) for a keeper to become familiar with the more common parasitic helminths and protozoans. I am not suggesting that a person with a microscope and a few manuals can fulfill the role of a trained parasitologist, but that it is possible to become familiar with the basic types of gastrointestinal protozoan and metazoan parasites. By regularly conducting weekly stool examinations for all the animals under his or her care, the keeper could reduce the chance of an animal quickly succumbing to an unknown carrier infection under conditions of stress.

An example of the need for frequent, regular stool examinations was shown at the Brookfield Zoo Primate House. A female siamang, approximately six years old, was received from another zoo on 12 April 1975. She was routinely quarantined and then placed in the collection on 16 May. A hospital stool examination on 3 June showed heavy trichomonads and light strongyles. Trichomonads are an intestinal protozoan not thought to be pathogenic unless present in large numbers. Strongyles are a parasitic nematode which can be extremely pathogenic. Treatment was undertaken with Flagyl to be administered over a nine day period. Unfortunately, the Flagyl wasn't readily accepted and very little was actually ingested. As of 7 June a stool sample showed a moderate number of strongyles and heavy trichomonads. Her stool was still normal and through a communications error no treatment of the strongyles was undertaken.

On 21 June she was bitten on the hand by an adult male siamang in an adjoining cage. Since the bite wasn't serious, and only minor swelling occurred, she wasn't removed for treatment. On 9 July her stool was extremely loose and she was separated from a young male siamang with whom she had been caged. Stool sample results on 11 July showed a moderate number of rhabditiform strongyles and light trichomonads. Treatment with Mintazole was begun with 1/5 of a tablet twice a day which was accepted with coaxing. Her weight was 12½ pounds (27.5 kg.). She was administered oral electrolytes and consumed small amounts of boiled apples and potatoes. From 11 to 13 July her stool improved somewhat and weight rose to 13½ pounds (29.7 kg.). On 16 July her diarrhea became considerably worse. The strongyles had increased in number and she refused fluids and foods and became extremely lethargic. She was removed to the hospital on 17 July for fluid and antibiotic therapy. Unfortunately, therapy was unsuccessful and she succumbed on 18 July.

The tissue cultures haven't returned as of the time of writing, but the autopsy showed heavy ulceration of the colon. In this instance, a regular weekly stool examination could have easily detected the increasing number of strongyles and proper treatment could have been initiated. It is possible that the stress induced by the bite and the immunological reaction to infection created a condition in which the parasites could flourish (Snyder, 1975). At the Primate House in Brookfield Zoo, a secondhand microscope has been purchased to conduct regular stool examinations. *The intention isn't to replace the existing veterinary program, but to add to it.* Such a program of regularly conducted stool examinations can only benefit the collection by possibly finding "silent" infections and monitoring their intensity. This combined with periodic examinations by trained parasitologists and microbiologists will help reduce the incidence of parasites in the collection and improve general husbandry.

As the role of zoos evolves and changes, it is essential that the keepers follow suit. If keepers want to be considered more than just glorified janitors, it is necessary that they go beyond the basic requirements of day-to-day animal care and learn as much about their animals as possible. This applies not only to parasitism, but to every aspect of their behavior and physiology.

1. Metronidazole, Searle Lab.

2. Thiabendazole, Merch, Sharp & Dhome

References:

Jeffrey, H.C., 1972. *Atlas of Medical Helminthology and Protozoology.* London, Churchill Livingstone.

Ruch, T.C., 1959. *Diseases of Laboratory Primates.* Philadelphia, W. B. Saunders.

Snyder, R.L., 1975. Behaviral stress in captive animals. In:*Research in Zoos and Aquariums.* Washington, D.C., National Academy of Sciences, pp. 41-76.

PARASITIC ZOONOSES IN A ZOO

by Elizabeth F. Bergstrom (*) (**)

Parasitism is one of the plagues of most living things. Although there are numerous zoonotic agents responsible for various infections that are shared by man and animals, most of these have not been important in the United States. In zoological gardens, parasitic diseases are often a result of a disturbance in the external environment and in the social relationships which directly upset the animal's normal physiological stability. If extended long enough these changes can influence, either favorably or unfavorably, the development and direction of these parasitisms or other potential zoonoses. Persons who do not live in endemic areas may not be aware of the dangers of possible infection. Our attention to this problem was drawn by a case of strongyloidiasis in a female keeper.

* Special microbiology section, Department of Medical Microbiology, Creighton Memorial St. Joseph Hospital, Omaha, Nebraska

** Study material was obtained at the Henry Doorly Zoo, Omaha, Neb. Dr. Lee Simmons, Director; Dr. Michael McCoy, Zoo Veterinarian. Support of the study was obtained from Dr. W. Eugene Sanders, Jr., Chairman of Medical Microbiology and Dr. Matt Severin, Chief of Clinical Microbiology of Creighton University, Omaha, Nebraska.

Case Report

A 24 year old white female keeper working with primates developed a transient rash for two to three months followed by generalized abdominal cramps, weakness, bloating, and diarrhea. Just prior to seeking medical aid, she manifested some wheezing and labored breathing.

When *Strongyloides* rhabditiform larvae were seen on a routine stool examination for parasites in July 1973, she was treated with oral thiabendazole (Mintezol) - "R" - the drug of choice. She was prescribed 1.5 gm twice daily for two days but was unable to complete the dose schedule due to side effects of dizziness, nausea, and incoordination. The post-therapy fecal examination revealed no *Strongyloides* larvae.

The keeper became symptomatic again in July 1974 and *Strongyloides* rhabditiform larvae were demonstrated in the fecal examination. Her symptons were similar to those of the previous year but were less severe and she did not manifest labored breathing. She was retreated with thiabendazole, completing an alternate drug regime, 1 gm. three times daily. She felt milder side effects of dizziness, nausea, and incoordination. Follow-up examinations to date have revealed no more *Strongyloides* larvae and she is presently well.

Strongyloides (and other parasites) may persist in the host (animal or man), eventually creating extensive pathologic changes and even death, especially in those who are immunologically depressed. Symptomatic manifestations of infection vary from slight to severe. They are influenced by the number of invading parasites, the susceptibility of the host to infection and the locality of the parasite in the host (9). Concurrent infection with other parasites and/or other infectious agents makes the diagnosis of strongyloidiases more difficult. Since manifestations of infection correspond largely with the parasitic life cycle, they are symptomatically categorized into syndromes, i.e. cutaneous, pulmonary and gastro-intestinal. Rare syndromes may also occur if the parasite travels to ectopic areas, of man or animals, which may affect the urinary (13), nervous (2), and cardiovascular (10) systems. It is also thought that *Strongyloides* infections of man may reactivate old tuberculosis lesions (12). However, the suppressed immune mechanisms of the infected host may be the reason for the reactivation. This constitutes a serious problem since tuberculosis can spread to and destroy a primate colony once any active disease is present (5).

Although *Strongyloides* infections are prevalent in tropical and subtropical areas where warm, moist soil conditions are present, it is sporadically reported in temperate areas throughout the world. The Omaha area is not endemic for *Strongyloides* infection in either man or animals. Therefore, an investigation was initiated in order to determine the specific identity and sourcee. Other human cases of *Strongyloides* seen in the local vicinity were assumed acquired from endemic locales prior to diagnosis as indicated by the case histories taken at the time of examination.

The Investigation

The studies were initiated in December 1973 and concluded in May 1975.

Fecal examinations for parasites and stool cultures for enteric pathogens were performed in duplicate (when possible) on animals in the zoological garden. Areas screened included both those sections where the infected keeper did and did not work. All employees were screened whether or not they had animal contact. In addition, the keeper's pet dog had been checked (prior to December 1973) for possible *Strongyloides* infection.

Fecal specimens were examined by the employment of the following techniques:

1. Direct fecal smears using normal saline for motile organisms and D'Antoni's iodine stain.
2. Concentration by the Ritchie Formalin-Ether Sedimentation (14) procedure. The sediment was examined for parasitic objects.
3. Culture in Hirsch Charcoal Medium (11) for intestinal protozoa.
4. Fixation with either Schaudinn's fixative or polyvinyl alcohol (PVA). Two slides were stained with phosphotungstic acid hematoxylin stain (3) for speciation of protozoa.
5. Petri dish culture at room temperature for free-living forms of *Strongyloides* and the production of filariform larvae.
6. Culture for bacterial enteric pathogens on MacConkey's medium, SS medium, and Selente F enrichment medium.

Results of the Investigation

Of the animals studied, the main pathogenic parasites found which have the potential to infect man were: 1. *Balantidium coli*, 2. *Entamoeba histolytica*, 3. *Strongyloides* species, 4. Hookworm species, 5. *Oesophagostomum* species.

Strongyloides larvae and/or eggs were demonstrated only in fecal specimens from the monkeys (*Saimiri scuireus, Cercopithecus mitis stuhlmann* and *Cercopithecus aethiops*) and orangutans (*Pongo pygmaeus pygmaeus* and *Pongo pygmaeus albelli*). Eggs and rhabditiform larvae were found in feces from the monkeys. The free-living adults cultured from these specimens were identified as *S. fulleborne* (8,4). Only rhabditiform larvae were seen in fresh fecal specimens from the orangutans and the free-living adults were identified as *S. stercoralis* (8,1).

Since the transmission of *Strongyloides fulleborne* infection from primate to man had been documented by Wallace, Mooney and Sanders (15) confirmation of species was necessary to establish the specific source of infection. The free-living adults cultured from the keeper were indentified as *S. stercoralis*. There were no eggs seen on her fresh fecal specimens. By careful consideration of the keeper's case history (including travel schedule, contacts and habits) it was concluded that she obtained strongyloidiasis from the orangutan group.

The first evidence of other parasitisms which might be shared, but not necessarily pathogenic, was seen in the first post-therapy specimen of the infected keeper. A flagellate was isolated on an ameba culture which could not be specifically identified by the available medical and animal parasitology references. A few days later an organism similar to the one isolated was seen on direct stained smears of a fecal specimen from a co-worker. Other similar type flagellates were isolated from animal feces and environmental specimens. The organism appears to be a free-living contaminant which evidently can pass through a mammal host. Its significance may be an indication of a need to change the exhibit design in order to improve management practices.

In addition, several keepers complained of gastrointestinal disturbances with cramping, intermittent diarhea and constipation, accompanied by malaise and headaches in varying degrees of severity. Of 45 persons examined, 10 had *Entamoeba histolytica* (large race), 22% demonstrable in the fecal specimens. A total of 17 persons (38%) had some species of intestinal protozoan common to the primate group with which they had contact.

The Health Department, Hospital Infectious Disease Staff and the Zoo staff met and it was decided to treat simultaneously both keepers and animals, who were infected with *E. histolytica*, with metronidazole (Flagyl) "-R."

During the course of her parasitism, the keeper with strongyloidiasis has acquired most ameba species and the intestinal trichomonad common to the non-human primate group. Although suspected, *E. histolytica* (large race) has not been demonstrated in the specimens examined to date. *Balantidium coli*, although potentially pathogenic, has not been seen in the persons infected with parasites.

The group of animals in the zoological garden with significant *E. histolytica* infections were the non-human primates; 60% harbored the organism. All of these animals had one or more intestinal protozoa.

Three persons carried *Salmonella* type B, however, no gastrointestinal disturbances could be attributed to this organism. None of the non-human primates were seen to harbor *Salmonella* or *Shigella* when cultured.

Oesophagostomum species infecting the spot-nose guenon group is a potential pathogen for human infection. Possible hookworm infections from the hoofstock area are probably not a danger in this situation.

Although intestinal protozoans are seen sporadically infecting persons of the Omaha area, the data collected indicates that most infections of the keepers have occurred as a result of the ingestion of cysts excreted by the animals.

Control Measures

One way to prevent and control the incidence of these zoonoses is by the treatment of animal and human individuals known to be infected with a potentially pathogenic agent. In conjunction with a chemotherapy regimen, other management practices must be employed which are aimed at breaking the life cycle of the parasite to prevent it from recycling through the host(s). One method is the rigid application of good techinques of personal hygiene that are known to prevent the acquisition of organisms normally transmitted by the fecal - oral or fecal - dermal route. In addition, environmental management should be designed to allow the keeper or animal minimal contact with animal material which may contain potentially pathogenic organisms.

Conclusions and Recommendations

Humans can indeed acquire infectious agents from animals and sometimes the disease is worse in man than

TABLE I

Results of Examination of 45 Zoo Personnel for Intestinal Protozoa

	Numbers Infected		
Areas covered	Protozoa	No Protozoa	*E. histolytica**
Hoofstock Area	3	3	3
Barn area (includes small mammal, Primate Research, Animal Kitchen, Hospital, Nursery, and Barn)	10	7	5
Cat and Bear Area	1	2	0
Zoo Supervisor	1	-	1
Other administration	0	3	-
Maintenance	0	6	-
Watchmen	0	2	-
Secretaries	0	2	-
Snake area	0	1	-
Total	17	28	10
Percent of total	38	62	22

*Percent of *E. histolytica* infections to total of protazoan infections: 60

in the original host. Most animals harbor a parasite of some species. Many are infected with multiple organisms which result in the development of symptomatic or asymptomatic disease and may be influenced by conditions of crowding and stress in an unnatural environment.

A careful and thorough surveillance of both the animals and keepers health should be arranged on a regular basis. Parasitology examination and bacterial culture are recommended in addition to routine physiological tests on each new individual so a deviation from normal may be readily detected and remedied.

Further study of these animals in the wild is needed with the follow-up data collection being extended into captivity.

Personal health hygiene standards for employees should be reviewed and revised in order to eliminate the transmisssion of parasites between animals and keepers.

Proper microbiological procedures must be employed by those persons working with infected material. This involves the development of new diagnostic techniques and procedures in order to ensure accurate indentification and analysis of the importance of

Tables ii

Results of Examination of Animals Found to Harbor *Entamoeba histolytica* (by group)

		E. histolytica	
	Groups	Found (+)	Not Found (-)
	Hoofstock Area		
	1. Gibbons	+	
	2. Oxen	ameba cysts morphologically similar to *E. histolytica*	
	Barn Area		
	1. Celebes	+	
**	2. Gelada	+	
	3. Rhesis	+	
	4. Golden Lion Marmoset		-
	5. Cotton-top Marmoset		-
**	6. Mandrill Baboon	+	
*	7. Squirrel Monkey	+	
	8. Ringtailed lemur		-
	9. Slow loris		-
	Cats and Bears Area		
	1. Spot nose guenon		-
	2. Blue monkeys	+	
	3. Green monkeys		-
	Gorilla Area		
*	1. Gelada		
*	2. Mandrill Baboon		
**	3. Squirrel Monkey		
	4. Gorillas	+	
	5. Orangutans	+	
	Total (excluding Oxen)	9	6

Percent of non-human primate groups to harbor *E. histolytica*: 60

Percent of non-human primate groups to harbor one or more species of intestinal protozoa: 100

* Winter quarters
** Summer quarters

the parasites found. In order to follow the best diagnostic regimen, a close communication among veterinarians, physicians, animal handlers and parasitologists should be maintained.

There is a need to investigate ways to alter the ecology among animals in captivity (i.e. the degree of dispersal) to prevent cross infection and increases in the parasite load.

It must be remembered that when an animal is brought into captivity (or relocated) and subjected to an unnatural environment with conditions of crowding and stress, its physiological well-being is depressed--which may allow for more favorable conditions for the parasite to propagate (6). Not only may the concentration of existing parasites in the host increase, but new parasites which were not in the animal's natural environment may be acquired accidently during captivity and transport to the relocation areas. In these animals the excretion ratio of various components of the fecal flora changes (7), thereby increasing the possiblility for transmission of potential pathogens to persons handling them. Non-human primates are more physiologically similar to man and therefore can harbor many zoonotic agents.

1. Chitwood, M.B. 1975 Personal Communication.

2. Faust, E.C. 1935. The pathology of *Strongyloides* infection. *Arch. Path.* 19:769-806.

3. Felsenfeld, O.F. and V.M. Young. 1945. An improved method for the examination of intestinal protozoa. *Amer. J. Clin. Path.* 9:47 - 49.

4. Greve, J.H. 1974. Personal communication.

5. Habel, K. 1947. Tuberculosis in a laboratory monkey colony. Its spread and control. *Am. Rev. Tuberc. Pulm. Dis.* 55:77 - 92.

6. Hediger, H. 1950. (Translated by Sircon, G. 1964). *Wild Animals in Captivity.* p. 114. Dover Publications, Inc., New York.

7. Kalter, S.S. 1970. Trends in microbiological investigations on the nonhuman primate (possible association with parasitological programs). *Lab. Animal Care.* 20 (2):333 - 336.

8. Little, M.D. 1966. Comparative morphology of six species of *Strongyloides* (Nematoda) and redefinition of the genus. *J. of Parasitol.* 52 (1): 69 - 84.

9. Marcial-Rojax, R.A. 1971. Strongyloidiasis. in *Pathology of protozoal and helminthic diseases.* pp. 711 - 733. Williams and Wilkins Co., Baltimore.

10. McCracken, J.P., Jr. 1957. Strongloidiasis with probably cardiac involvement. *No. Carolina Med. J.* 18:186 - 190.

11. McQuay, R.M. 1956. Charcoal medium for growth and maintenance of large and small races of *Entamoeba histolytica. Amer. J. Clin. Path.* 26:1137 - 1141.

12. Palmer, E.D. 1944. A consideration of certain problems presented by a case of strongyloidiasis. *Amer. J. Trop. Med.* 24:249 - 254.

13. Redewill, F.H. 1949. *Strongyloides stercoralis* involving the genito-urinary tract. *Urol. & Cutan. Rev.* 53:609 - 614.

14. Ritchie, L.S. 1948. An ether sedimentation technique for routine stool examination. *Bull. U.S. Army Med. Dept.* 8:326.

15. Wallace, F.G., R.D. Mooney, and A. Sanders. 1948. *Strongyloides fulleborne* in man. *Am. J. Trop. Med.* 28:299 - 302.

A NEW DESIGN FOR THE DISPLAY OF SMALL PRIMATES

by Robert L. Evans, Santa Fe Teaching Zoo Gainesville, Florida

One of the primary aims of the Santa Fe Teaching Zoo is the development of more "natural" methods of displaying zoo animals. In view of this aim, I designed and constructed a habitat in 1974 which incorporated platforms designed to allow a group of squirrel monkeys access to the branches of two pine trees and to prevent their escape.

The idea was suggested by a description of a platform in Leonard Williams' **Man and Monkey** (1968) which was designed to allow caged Woolly monkeys access to nearby trees; however this was designed to allow more convenient tree access to the monkeys and not to prevent their escape.

Since the Santa Fe Zoo is not blessed with this luxury of surplus space it was necessary to restrict the range of our squirrel monkey colony. The site chosen was two large isolated pine trees.

The main cage was built around the bases of these two trees and communicated with the platforms by means of a wire "tube" seven inches in diameter. The platforms were eight feet square and located approximately 35 feet from the base of the trees. Any limbs hanging below 35 feet were cut off at that height. It was felt that his height was sufficient to discourage any attempt to jump to the ground and that the width of the platforms would efficiently prevent the monkeys from jumping to the tree trunk or to the "tube". These assumptions apparently were correct and the measurements probably exceeded minimum requirements.

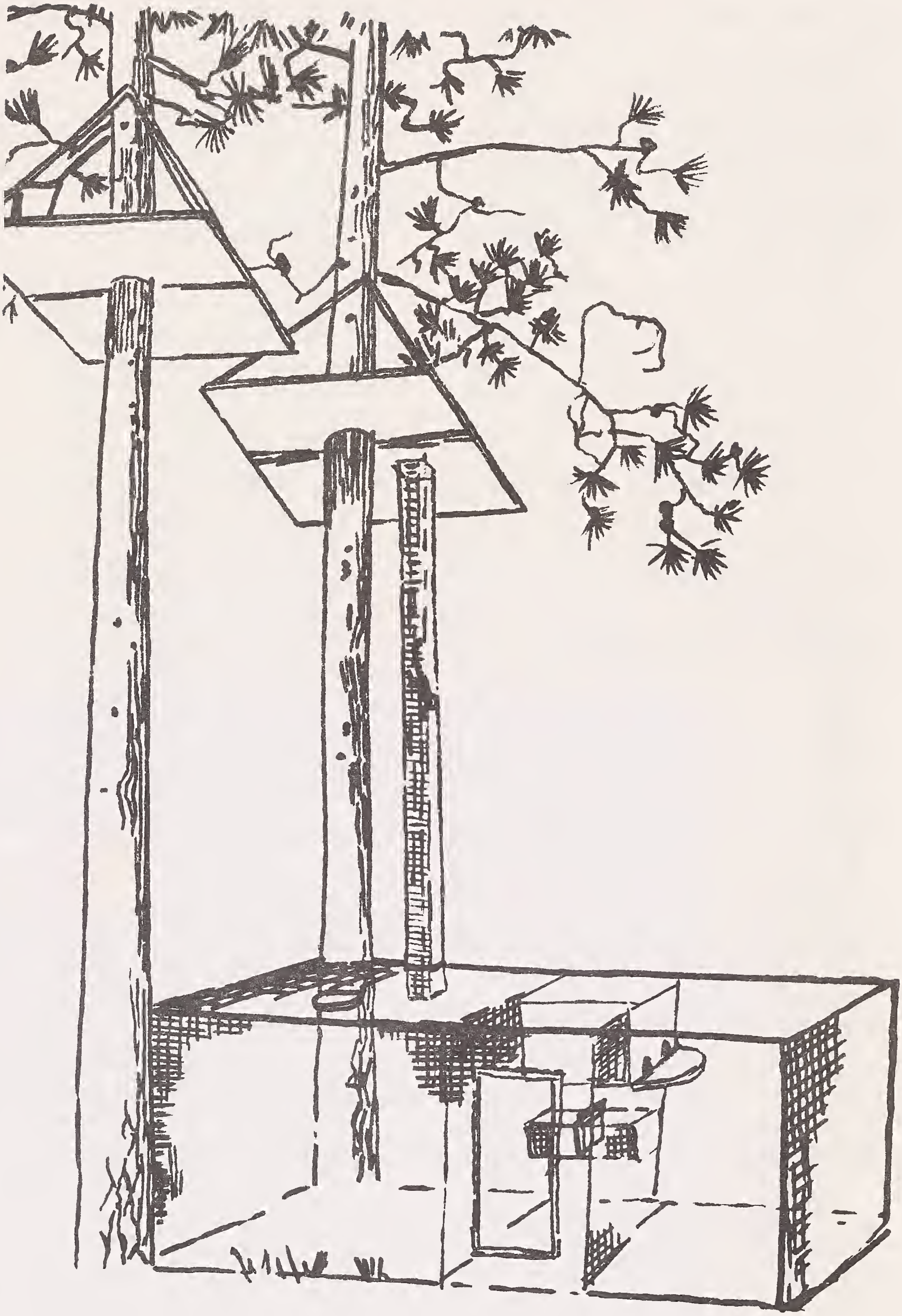
The primary concerns in the design were to develop something which would display the animals in as apparently natural a setting as possible, which would prevent escapes, and which would not pose a danger of injury to the animals.

The design was completed and the animals introduced in early January 1974. The platforms were destroyed by a storm in the fall of that year, thus remaining in use for approximately nine months out of the year.

That the animals appeared "free" is demonstrated by the fact that on occasion visitors to the zoo reported "escaped monkeys" which proved to be the squirrel monkeys frolicking in their trees. The animals leapt about from limb to limb or sat on the edge of the platforms and observed activities in other areas of the zoo. Often they would spend the entire day in the trees and come down only at feeding time. They may also have stayed in the trees to sleep on warm nights.

In the nine months which they occupied the platforms, not one animal was injured. However, pine sap caused a small problem and some discomfort to the animals. Two small shelves were nailed to the trees in the cage and the sap dripping from the nail "wounds" collected on the shelves and became matted in the animals' fur. After about two weeks the sap dried and flaked off the animals. No further such problems occured.

The record for escapes was not flawless, but there is no reason to believe that his was due to any defect in the design. Two escapes occurred but neither was observed, the animals being found clinging to the main cage in the morning on each occasion. The cause of these "escapes" is believed to have been falls, since the smaller limbs of pine trees are exceedingly limber and the needles very slippery. It is doubtful that his problem would have occurred if another type of tree had been used. However, there is a possibility that the platforms were not wide enough, but this seems quite unlikely. It is interesting to note here that even on these occastions, with falls of at least 35 feet onto grass, the animals sustained no injuries.



The problems encountered are believed to have been the product of two mistakes in construction. The first was the choice of pine trees instead of another more sturdy species. However, it would be difficult to find another type tree with the unobstructed trunk length of a pine. There is also the possibility that after a time the animals would learn to move about in a pine as well as they could in any other type tree, although some falls may occur in the beginning. This presents the most serious difficulty in this design.

The second error was in the actual construction of the platforms. Each was made of two four by eight foot sheets of ¼ inch plywood, suspended by chains from large hooks embedded in the trees and nailed to the trees at the base of the platform. bottom supports could not be used as the animals could climb down these to the tree trunk. The lack of engineering skill employed in this construction resulted in the platforms being too unstable to withstand strong winds and they were destroyed in tornado winds.

This disaster terminated the experiment and the platforms have not been rebuilt, but reconstruction in a more sophisticated manner is under consideration.

In summary, we feel that the duration and success of this temporary, experimental structure indicates positive possibilities for this design as a display for certain small primates. The problem associated with this particular structure are believed due to my lack of engineering skills and an unfortunate choice of speices for the supporting trees.

A sophisticated implementation of this design would, in all probability prove to be a pleasing and efficient method of displaying certain small primates.

Literature cited:

Williams, Leonard (1968) *Man and Monkey*, J. B. Lippincott Co., Philadelphia.

FIRST 40 DAYS OF A SNOW LEOPARD

by Randy McGill, Detroit Zoological Park, Detroit, Michigan

On 7 June 1975, the first snow leopard cub *Panthera uncia* was born at the Detroit Zoo. It was obvious that the mother did not care to perform her motherly duties. That, coupled with the danger of the father devouring the kitten, a decision was made to transfer the cub to the Zoo hospital. This is a brief account of the first forty days of handrearing that snow leopard.

Upon arrival at the hospital the cub weighed 1 lb. 1½ oz. with a body temperature of 98.8°F (100°F considered normal). The cub was injected with 0.2 cc. of combiotic (penicillin streptomycin) and it ate 0.5 oz. of KMR (Kitten Milk Replacer by Borden), a domestic kitten diet. The snow leopard was then placed in an incubator with the temperature maintained in the upper 70's. By the end of the first day "Tiffany", as she was named, had eaten 5 oz. of KMR. The stools were good except for the last feeding (9 p.m.) when the stool was soft. This soft feces was to be a problem throughout the first forty days.

The medication program throughout the first forty days was aimed primarily at arresting the diarrhea problem, either by adding medication or by taking it away, in hopes the stool would firm up. After the appearance of the soft stool on the first day, on only seven of the next thirty-nine days would the stool be considered normal - the eighteenth and nineteenth days and the twenty-second through the twenty-ninth days. The stools were checked at each feeding and the cub was voided with a massage at the same time.

On the second through the fourth days, 0.4 cc. of combiotic was injected. On the third day, four drops of Zymadrops (vitamins) were given. Zymadrops were discontinued after the sixth day to see if the feces would firm up. They were resumed on the seventeenth day. On the fifth day the combiotic was replaced by four drops of Hetacin-K, a broad spectrum penicillin, given twice a day and was continued for thirteen days.

The diarrhea of the first seven days created tenderness in the rectal area. On the eighth day, Panalog (Squibb) and A & D Ointment (Schering Co.) were applied to the sore area. On the tenth day, Furacin Dressing (Eaton Laboratories) antibiotic salve, was applied to the rectal area four times. A & D Ointment was administered on the eleventh through the fourteenth day and Furacin Dressing was applied on the fifteenth through the eighteenth day. The treatment was deemed no longer necessary after that time.

Also used to combat the diarrhea was an anti-diarrheal agent, Kao-Con (Upjohn). Kao-Con was first administered on the eighth day when a dosage of 0.3 ml. was given. Kao-Con was to be given every day from then on in varying quantities ranging from 1.2 ml. to 0.6 ml. (thirty-seventh day). From the nineteenth through the thirty-third day, Kao-Con and Zymadrops, in the quantity of 6 drops, were to be the only medication the cub received.

On the thirty-fourth day the stools were found to contain a considerable quantity of blood and mucus and the body temperature had risen to 101.7° F. The cub was taken off solid food and was treated with 5 drops of Hetacin-K and 0.06 ml. of Biosol-M, an oral antibiotic, twice. These treatments were repeated over the next three days, but on the morning of the thirty-eighth day the stool contained a large amount of blood with mucus and the body temperature was 102°F. The cub received 0.7 cc. combiotic injected into the muscle and 4 cc. of feline serum injected under the skin. Hetacin-K and Biosol-M were given for the last time that day. On the thirty-ninth day 0.7 cc. combiotic was injected and on the fortieth day, the cub was back to Kao-Con and Zymadrops as the stool was still soft with traces of blood.

The feeding schedule was 9:00 a.m., 1:00 p.m., 5:00 p.m. and 9:00 p.m. For the first nine days the snow leopard was fed KMR alone. The amount increased from 5 oz. the first day, to 8 oz. the sixth day, to 10 oz. the seventh day. On the tenth day, a formula to prevent scouring consisting of 1 tsp. sodium chloride, ½ tsp. sodium bicarbonate, 4 oz. dextrose, and 4 pts. of water, was added to the diet. The cub received 4 oz. of scouring formula per day until the thirty-ninth day when it was decreased to 3 oz. and reduced again to 2 oz. on the fortieth day. With the addition of the scouring formula, the KMR was reduced to 6 oz. a day until the seventeenth day, when it was increased to 8 oz. a day. On the eighteenth day solid food was introduced into the diet (1/4 tsp. of C/D (Hills) at each feeding). It took only three days for "Tiffany" to double her solid food consumption. KMR was increased to 10 oz. on the twenty-eighth day and to 12 oz. on the thirty-ninth day. Because of the use of penicillin, C/D was stopped from the thirty-fourth through the thirty-seventh day. Pablum was added (3 tsp. daily) to the diet on the thirty-eighth day and was increased to 4 tsp. on the thirty-ninth day. By the fortieth day the cub had more than quadrupled its weight - to 4 lbs. 12 oz.

The milestones that made the wark all worthwhile fell on the ninth day when the eyes began to open, the twelfth day when the cub was first observed grooming itself, and the thirtieth day when the canine and upper incisor had erupted.

OBSERVATIONS ON MARAS AT THE SALISBURY ZOO

by Stefan H. Graham, Salisbury Zoo, Salisbury, Maryland

The following are some brief notes on mara's *Dolichotis patagonum* or Patagonian cavies. It will trace their history at the Salisbury Zoo from their inception here 7/16/73 to 11/1/74. During this period there have been two (2) replacement animals.

History

MALE 1 (M1)

Born: Oklahoma City Zoo (hand reared) (Date ?)
10/28/71 - received - National Zoological Park
2/4/73 - left eye shut - treated
7/16/73 - received at Salisbury Zoo (breeding loan)
8/3/73 - losing motor control over hindquarters. Running into stationary objects.
8/6/73 - returned to National Zoo for diagnosis and treatment.
8/7/73 - dead. Aberrant roundworm lodged in brain.

FEMALE 1 (F1)

Born: Oklahoma City Zoo (hand reared) (Date ?)
10/28/71 - received - National Zoological Park
5/21/73 - Given nest box, tried to burrow out of cage, looked heavy.
7/16/73 - received at Salisbury Zoo (breeding loan)
1/17/74 - killed by vandals

MALE 2 (M2)

Born: Lincoln Park Zoo (Date: 1973)
8/20/73 - received Salisbury Zoo (purchase)
1/20/74 - wound inflicted by vandals, checked for lead pellet (negative)

FEMALE 2 (F2)

Born: Lincoln Park Zoo (hand reared) (Date: 9/17/73)
1/23/74 - received Salisbury Zoo (purchase)
8/15/74 - gave birth to twins - 20 minutes apart

M2 was introduced 8/20/73 with no apparent problems, Within two (2) days a pair bond appeared to have formed and the two became practically inseparable. On 9/22/73 both escaped by burrowing under the fence. (All burrowing, until the one which they raised young successfully, was done at the perimeter and particularly in corners).

After the excape, M2 and F1 were placed in the experimental pen. On 10/10/73 a major burrow was begun and was filled in by staff daily until November 1 when they were allowed to complete it (see Burrow).

On 1/17/74 vandals broke into the zoo killing and removing F1 and wounding M2. On 1/23/74 F2 placed with M2.

On 1/15/74 burrow excavated by staff (see burrow). New burrow begun about 3/15/74 in center of exhibit. Twin birth takes place outside burrow on 8/15/74. At this time F2 was only 11 months old. Considering gestation to be about 88 days (D. Kleiman, personal comm., 11/74) F2 must have only been about 8½ months when she conceived.

Activity

Pair practically inseparable prior to birth. Appear to be matriarchal when raising young (contrary to our experience with capybaras) but to a great extent care of young was shared. Male never showed aggression toward young. Both parents seemingly unconcerned when young were picked up following birth (see interaction) when frightened pair moves in perfect unison.

On August 31 first courtship dance

observed. Extremely active July 16 (courtship, etc.). Although if gestation material is correct, young must have been conceived at this time. Both are most active at mid-afternoon and have never been known to be in burrow at night.

Breeding was never observed.

Territory

Fecal material generally found in an area 3' square. Dust bathing does not take place in this area. Do not appear to defend any territory, even their burrow.

Diet

7/16/73 to 1/23/73

Guinea pig diet (Purina) ad lib - (appox. ½ quart)
2 carrots (cut-up)
4 sweet potatoes (cut-up)
2 bananas (cut-up)
2 apples (cut-up
2 apples (cut-up)
1 orange (cut-up)
graze (ad lib)

7/23/73 to present

½ quart guinea pig diet (Purina)
½ quart Dry Primate diet (Hill's - Riviana)
handful of greens (collards, kale, endive, etc.)
1 carrot (cut-up)
2 sweet potatoes (cut-up)
graze (ad lib)

The maras graze constantly winter and summer, generally preferring green shoots but also taking dead plant material. They prefer the dry primate diet. Will not eat stalks of collards although will eat banana peels.

Although fresh water and a free flowing stream are available to them, they have never been observed drinking.

General Information

Although fed in a small house (4' x 3' x 2' high) containing a heat lamp, they will pull the food outside and have only once been seen under the heat lamp. This was at night but not on a particularly cold night. We have seen no signs of frost bites.

Positions

Sit upright, front legs stiff and back legs under like a dog. Lying with front feet out and rear feet tucked under body. Lying with front feet out in front and rear feet to the side.

The animals have been held in only two (2) areas since their arrival at the zoo. Brief description of each follows:

South American Plains
7/16/73 to 9/22/74

W - 118'
l - 229'
Moat - 13'

Buildings: guanaco shed 10' x 10' x 7' high
mara she 4' x 3' x 2' high

When first introduced to this area the maras were kept behind a 50' circle of snow fence to become acclimated. After three (3) days this was raised 12" to allow them access to outer area but also a safe retreat. All fence was removed after one (1) week.

At the time the maras shared this area with 1.3 adult guanacos, 1.1 crested cara cara, 1.1 King vulture, 1.1 ocellated turkey, 1.1 salvin's razor-billed currascow and 1.3 adult rheas.

Experimental Pen
9/22/74 to present

Front 157'
Rear 166'
Right side 42'
Left side 70'

This includes a portion of a free flowing stream 1,660 sq. ft. in area.

Buildings: shed 8' x 9' x 7' high
mara shed 4' x 3' x 2' high (heatlamp)
nene house 3' x 2' x 3' high

The maras have shared this area with various waterfowl, 1.1 breeding black swan, 1.1 emu (see later), and a breeding pair of nene geese.

The original pair M1 and F1 were placed in the South American Plains exhibit 7/16/73. They stayed here with no problems until 8/6/73 when M1 was returned to the National Zoo where he died of an aberrant roundworm lodged in the brain.

Moving

Normal walk.
Running
Running stiff-legged (fearful)

Vocalization

None

Interaction with Other Animals

Guanacos chased them at first. During the birth the emus were watching intently and stepped on one of the young inadvertently. Emus later moved as they were most interested in the young.

Burrowing

The first attempt to burrow was excavated by the staff on 1/15/74 and found to be:

Lenght - 31' +
Width - 2'3" to 12" (generally)
Depth - 1'4" to 5'

The burrow begun 3/15/74 was successful in producing young and to this date, has not been excavated. Work on the burrow generally took place at night with a light cover of fresh earth at the mouth of the burrow in the morning. Dirt was leveled and no mound was allowed to form. Bedding placed in mouth of burrow was always removed.

D. Kleiman (personal communication, 10/74) felt the mouth of burrow might be used for dust bathing although we never observed this.

Birth

The birth took place about 11:45 on 8/15/73 and was not completely unexpected as for about one (1) week the female appeared gravid and the teats were slightly protruding. Birth occurred in the sand at the mouth of the burrow and appeared to be uneventful. About 20 minutes passed between the two (2) births and the whole process took about 40 minutes.

As mentioned earlier, emus kept in the area were most interested and stepped on one of the youngsters, they were then removed.

It appeared that F2 was rolling the young in the dirt at the mouth of the burrow to dry them off but this may not have been the case. Kleiman (personal communication, 10/74) thinks this may have been ritual sand bathing of an instinctive nature.

At about two (2) weeks the young began to take some solid food but presently (90 days) they are still nursing occasionally.

SEXUAL BEHAVIOR AND REPRODUCTION IN CAPTIVE GEOFFREY'S CATS F. GEOFFROYI

by Mike Kachuba, Beardsley Zoological Gardens, Bridgeport, Connecticut

Introduction

Information concerning reproduction in Geoffrey's cats *Felis geoffroyi* is scarce. We have had two females in our collection since 1973, and in 1975 we received a male. Observations were made beginning April 2, 1975, as to sexual behavior, mating, gestation and birth. Mating, and subsequently birth, occurred; unfortunately, the young was destroyed by the mother. It is the purose of this paper to provide information on sexual behavior, mating, gestation, and birth in Geoffrey's cat.

Materials and Methods

One male Geoffrey's cat, aged 10 months, and two female Geoffrey's cats, aged three years and five years, were kept in an indoor enclosure. This is a double cage, each unit 1.7m x 1.7m x 3.7m, separated by a cinder block wall with an elevated door, and a floor level door. The cage is enclosed on three sides by a cinder block wall, with a wire mesh front for public exhibit. There are two climbing trees in each unit, plus a hollow log in the unit which will be referred to as Unit A. The unit without the log will be referred to as Unit B. There is continuous running water in each unit. The cats are kept under diurnal lighting with 10 hours of simulated sunlight, 14 hours of darkness. The temperature in the cage is kept between 75°-80°F.

The three year old female is referred to as Female 1, the five year old female is referred to as Female 2. All three cats are fed approximately three-quarters of one pound each of Zu-Preem Feline Diet, with occasional live food. Cats are fed once a day, at night. Observations were made concerning sexual behavior, mating, gestation and birth, upon introduction of the male.

Results

When the male was introduced to the females, he stayed in Unit B, with no attempt to move to Unit A, where the females were located. Female 1 made the first move to him. She paced under his tree continuously for fifteen minutes, and then climbed the tree next to his, although not reaching the same height as the male. Throughout this action, she issued a high-pitched gutteral sound. Female 2 moved to Unit B and passively observed the cats in the trees above.

Both females began to ascend and descend the trees continuously, but only Female 1 made contact with the male. Upon contacting the male, she would rub herself against the tree, both on its branches and its base. At one point, Female 1 ascended the tree of the male and began licking his head. This action was reciprocated by the male. There was much more acceptance of the male by Female 1 than by Female 2 at this point.

Following the licking action, a chase, initiated by Female 1, ensued between she and the male throughout both units. Direction was reversed by the male, and he attempted his first mount of Female 1 but was rejected. Following this attempt, he immediately tried to mount Female 2, but she also rejected him. No intromission was observed in either case. There was absolutely no acceptance of the male by Female 2.

On the second day of observations, the activity was quite similar to the first day. The licking and chase actions between Female 1 and the male both occurred. This time, however, the genitals of the male were also licked by Female 1. Female 1 then moved to Unit A, with the male following. He attempted to mount her, but was again rejected. After this rejection, the licking and chasing ensued again. A short time after the chase began, the male mounted Female 1, with intromission, for sixty seconds. However, a loud noise from outside the building startled them, and they both ascended a tree. After a five minute period, they both descended and resumed copulation, with intromission, for a two minute period.

After the two minute copulation, they parted and both ascended the tree in Unit A. This was the last of the sexual activity that was observed. Observations were made daily for the next two weeks, and all activity was routine (i.e. pacing, climbing, etc.) with no sexual activity occurring.

There was no visible estrus during the period of introduction of sexual activity. There was no visible sign of pregnancy following copulation. Food intake, activity, and temperament all remained the same. On June 16, 1975, Female 1 gave birth to one young. It appeared she was going to take care of it, but approximately three hours after birth, she ate it.

Gestation period was 74-75 days.

Discussion

As stated previously, there is little, if any information concerning breeding in Geoffrey's cats. Our two females were both considered sexually mature, although none of the keepers ever observed estrus. It was not known if the male was sexually mature because he was only 10 months old at time of introduction.

Walker (1968) reports that, in general, small felids have one or two litters per year, with a gestation ranging from 55 to 80 days. The litter size will range from one to six. It was observed that our Geoffrey's gestation was 74 to 75 days with one young being produced.

The behavior of Female 1 was of particular interest. It was evident that Female 1 initiated the breeding activity. The male was passive until she began the sexual activity. The constant rubbing against the trees after contact with the male seemed to be a response, perhaps of sexual arousal of the female, to the male. It appeared to be a form of scent marking. Ewer (1973) states that in many carnivores, the frequency of scenting increases during mating. In territorial species this is associated with the importance of ownership during this period. In solitary species, it is an aid to finding each other. I believe in the case of our Geoffrey's cats, the rubbing action by the female was a definite response concerned neither with ownership or discovery, but rather caused by the excitement of a new individual (especially a male) being introduced in such close quarters. The rubbing was not a continuous action, such as the chase or licking actions. In fact, this form of scent marking occurred only on the first day of introduction.

The copulatory posture was much the same as reported by Ewer (1974), in that the female would lie down with forequarters flat, hindquarters raised, and the male would mount her with his forepaws on her sides. In this case no lordosis was observed. The neck bite used in felid copulation as reported by Ewer (1974) was evident here.

One interesting point that should be mentioned is that our Geoffrey's are primarily arboreal. Their mating posture also suggests this. However, all attempts at copulation took place on the ground.

The young was found on the ground, but it is not known if it was delivered on the ground or in the trees. It was carried into the log by the mother, and it was hoped rearing would take place here.

Summary

On April 2 and 3, 1975, sexual activity was observed between our three year old female and ten month old male Geoffrey's cat (*F. geoffroyi*). No copulation lasted more than a two minute period. There was no observa-

ble estrus, or pregnancy. Typical felid copulatory positions were assumed, and courting behavior between the pair was easily observed before copulation. There was no increase or decrease in activity, or the amount of food eaten by the female, nor was there any temperament change during her pregnancy. Gestation was 74-75 days with one offspring being produced, and eventually destroyed by the mother.

No. of Attempts by the Male on Female 1	**No. of Times Intromission Was Attained**
4	2
No. of Attempts Male Made on Female 2	**No. of Times Intromission Was Attained**
1	0
Gestation	**No. of Young Produced**
74-75 Days	1

References:

Ewer, R.F., 1973. *The Carnivores,* Cornell University Press, Ithaca, N.Y.

Ewer, R.F., 1974. "Viverrid Behavior and the Evolution of Rproductive Behavior in the Felidae," *The World's Cats,* edited by Randall L. Eaton, Feline Research Group, Woodland Park Zoo, Seattle, Washington.

Walker, Ernest P., 1968. *Mammals of the World,* Vol. II, John Hopkins Press, Baltimore, Maryland.

NOTES TO AUTHORS

The Keeper: Journal of the American Association of Zoo Keepers is an annual publication, featuring articles on all aspects of zoo technology. Authors need not be members of the Association, but are encouraged to join.

Submitted manuscripts should reflect original work or ideas or should lend additional information to a previously published work. Authors should strive to present their paper in a clear, concise manner. The editors suggest that, before submitting a paper, the author ask a qualified person to review it. Submit a typewritten manuscript on 8½" by 11" white paper; please double space the entire text. Tables, photos and drawings should not repeat facts from the text. They should be on separate paper, placed at the end of the manuscript. Their location in the text may be indicated by marks.

The Literature Cited section should take the following form for books and articles:

Crandall, Lee S., 1964. The Management of Wild Mammals in Captivity. Univ. of Chicago Press, Chicago, 769 pp.

Mallinson, Jeremy J.C., 1974. Establishing mammal gestation periods at the Jersey Zoological Park. Int. Zoo Yb., 14: 184-187.

Illustrations should be with black ink on white bond 8½" by 11" or smaller. Photographs should be black and white glossy, 8" by 10" or smaller. They should be sharply focused with good contrast.

Manuscripts should be submitted to Editors, The Keeper, 635 Gage Blvd., Topeka, Ks. 66606.

DEADLINE IS 1 SEPTEMBER, 1976 FOR VOLUME 2.

CONTENTS

CARING IS THE FIRST STEP by Barry N. Wakeman 1

A SUCCESSFUL REINTRODUCTION OF A HAND-REARED COTTON-TOP MARMOSET (*Saguinus oedipus*) TO ITS FAMILY by Kathryn LeClere 3

ORANGUTAN TOOL USE AT OKLAHOMA CITY ZOO by Jim Ellis Jr. 5

KEEPER INVOLVEMENT IN ZOO RECORDS by Robert Peel . 7

DIETARY SUPPLEMENTS FOR PENGUINS AT THE BALTIMORE ZOO by Janet J. Gailey 9

A KEEPER BASED PROGRAM FOR MONITORING ENDOPARASITES by Jeffrey A. Roberts 11

PARASITIC ZOONOSES IN A ZOO by Elizabeth F. Bergstrom 13

A NEW DESIGN FOR THE DISPLAY OF SMALL PRIMATES by Robert L. Evans 19

FIRST 40 DAYS OF A SNOW LEOPARD by Randy McGill . 21

OBSERVATIONS ON MARAS AT THE SALISBURY ZOO by Stefan H. Graham 23

SEXUAL BEHAVOIR AND REPRODUCTION IN CAPTIVE GEOFFREY'S CATS by Mike Kachuba 26

ANIMAL KEEPERS' FORUM
TOPEKA ZOOLOGICAL PARK
635 GAGE BOULEVARD
TOPEKA, KS 66606

ADDRESS CORRECTION REQUESTED
RETURN POSTAGE GUARANTEED

NON-PROFIT ORG.
U.S. POSTAGE
PAID
TOPEKA, KS
PERMIT NO. 631

AMERICAN ASSOCIATION OF ZOO KEEPERS